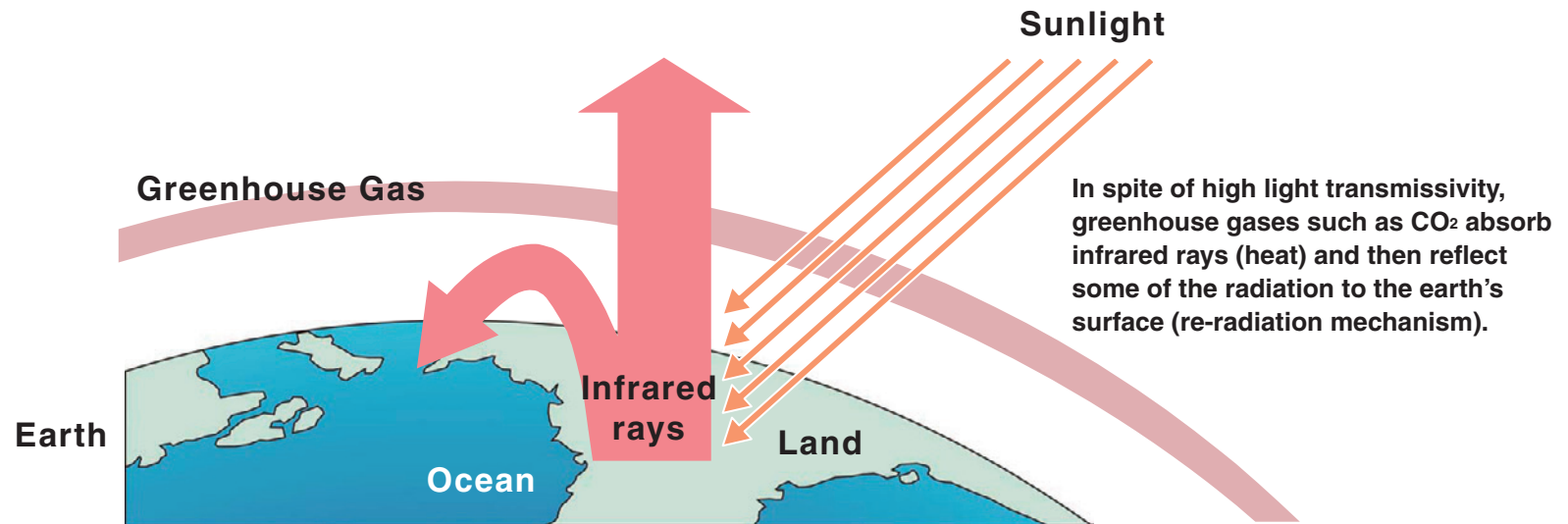
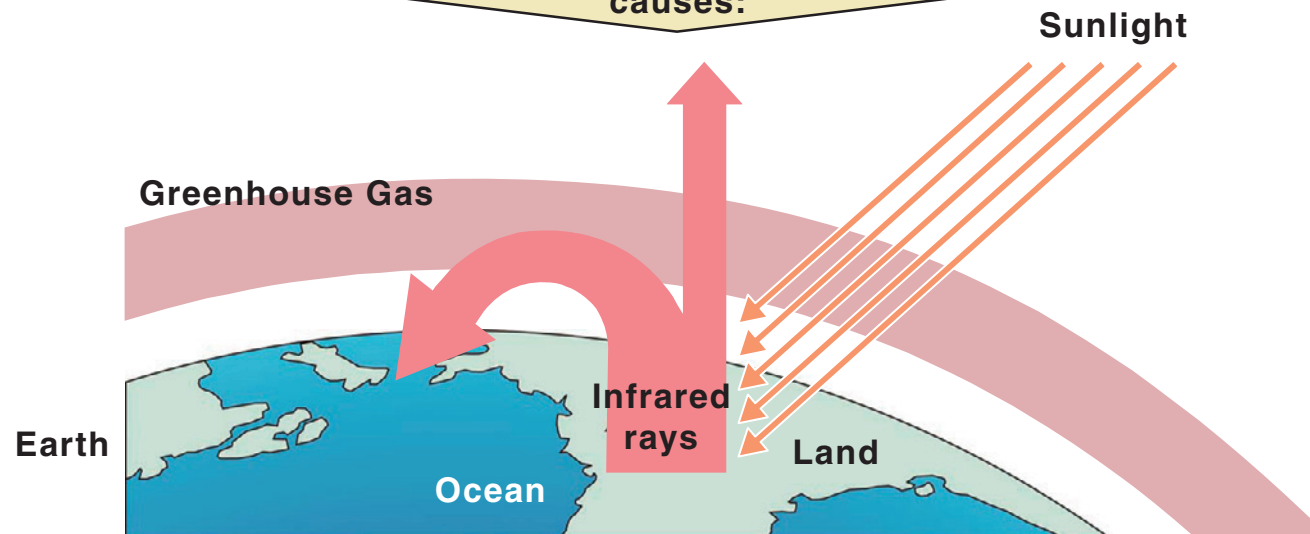


# Mechanism of Greenhouse Effect



Further increase in greenhouse gas causes:

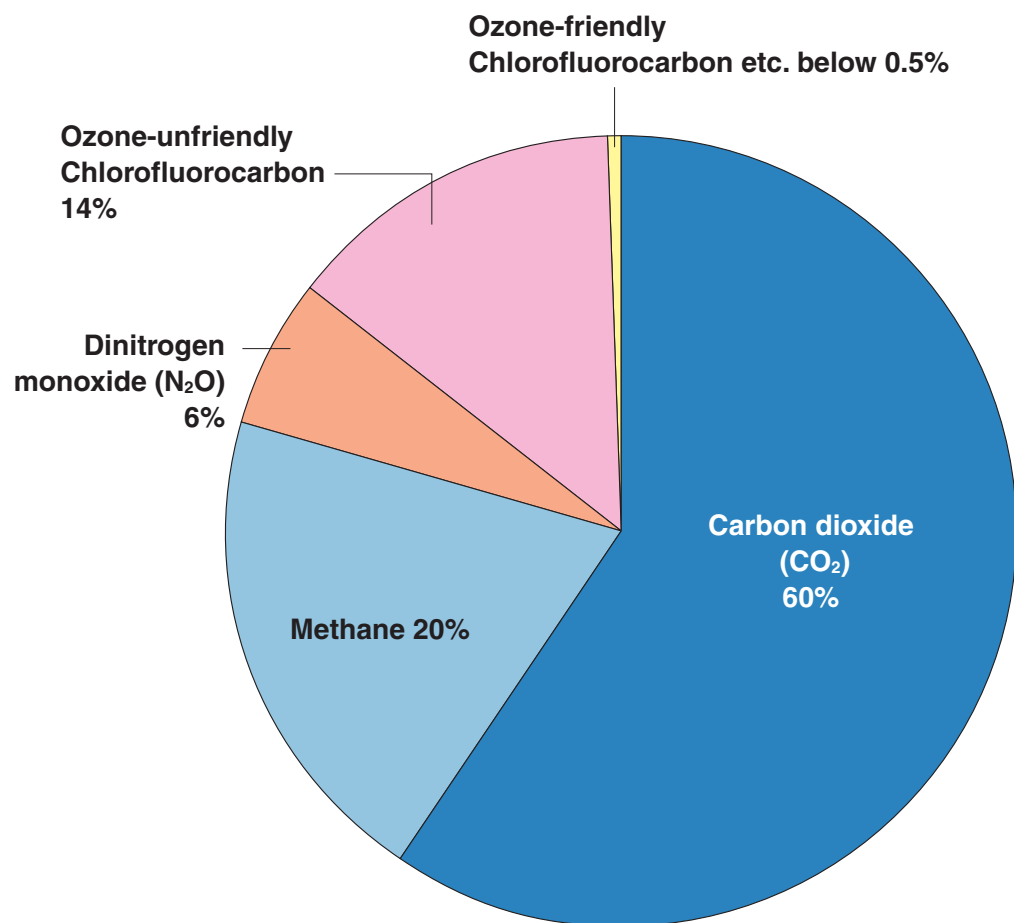


VISIT...

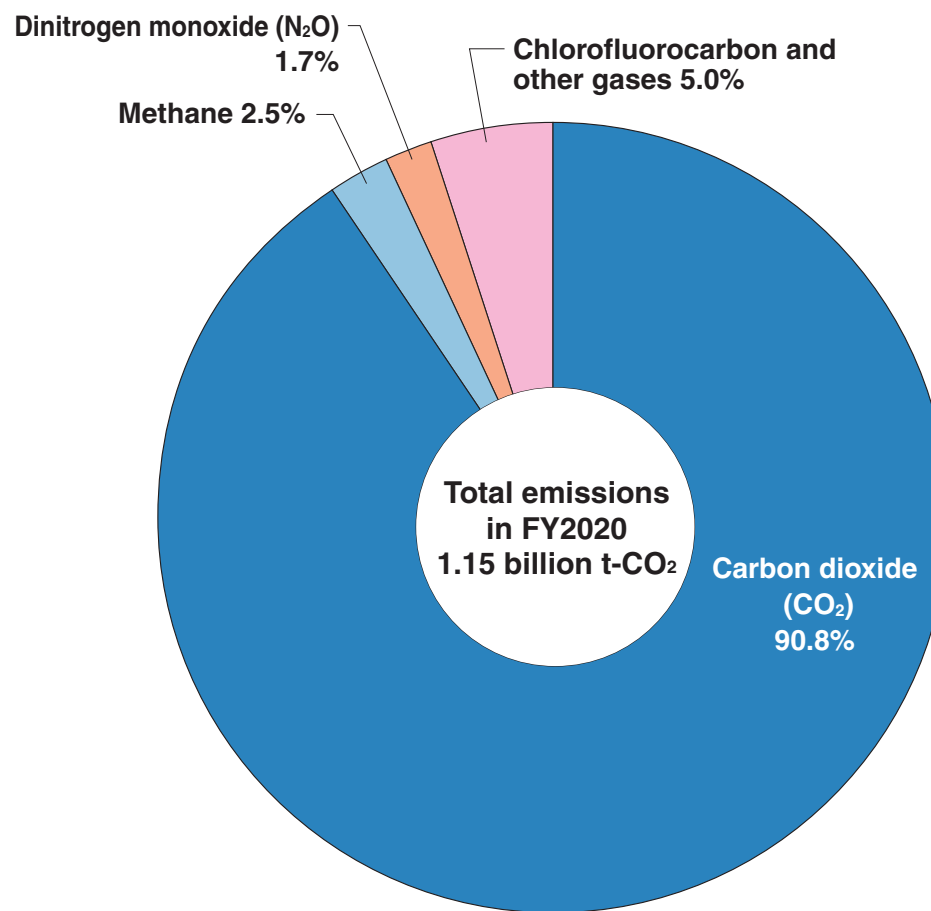
LANZAROTE  
*Caliente*.COM

# Contribution of Greenhouse Gases to Global Warming

Direct contribution to global warming of  
GHGs emitted by human activities  
after the Industrial Revolution

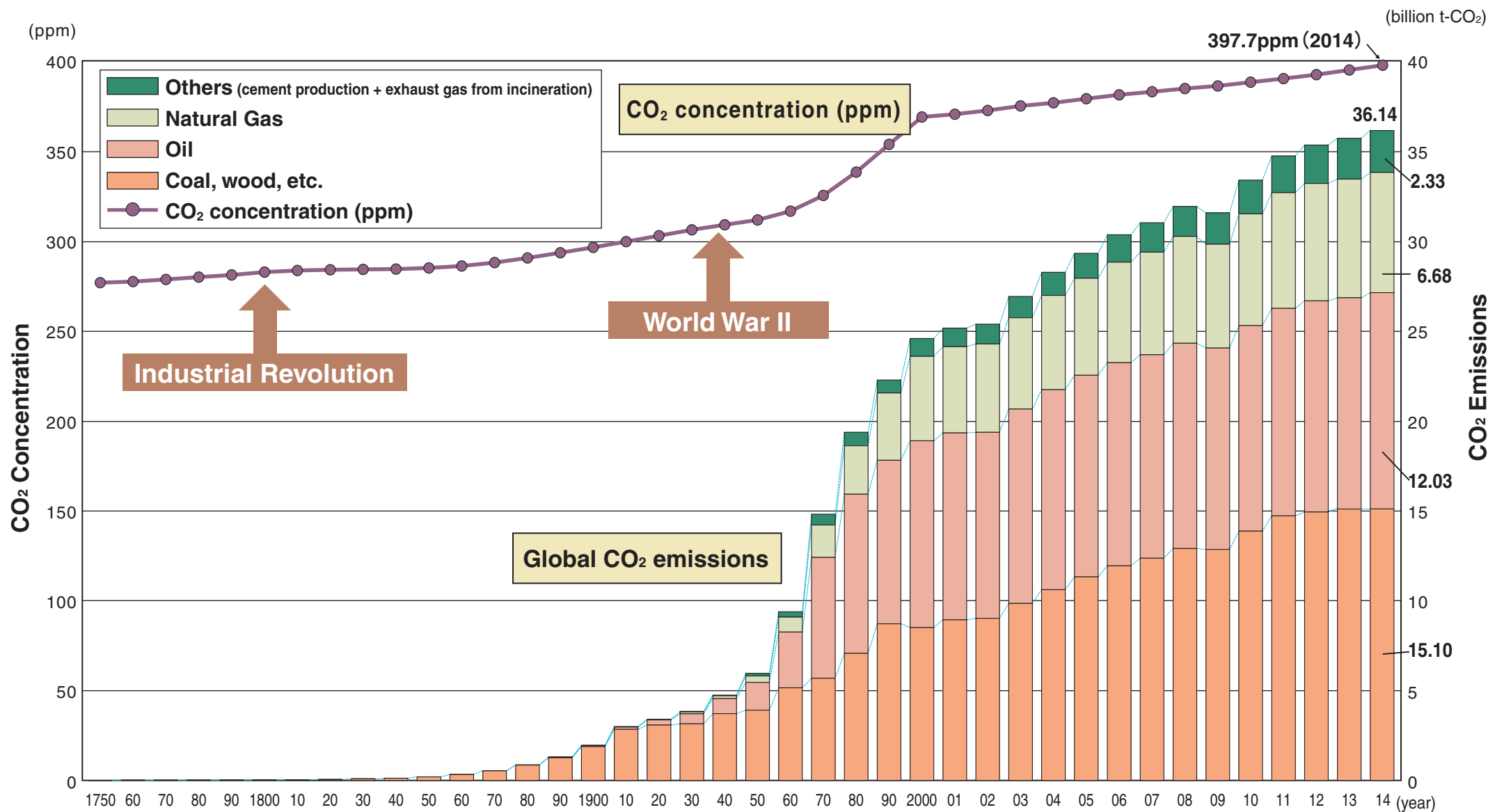


Direct contribution to global warming of  
GHGs emitted by Japan  
(for the single year of fiscal 2020)



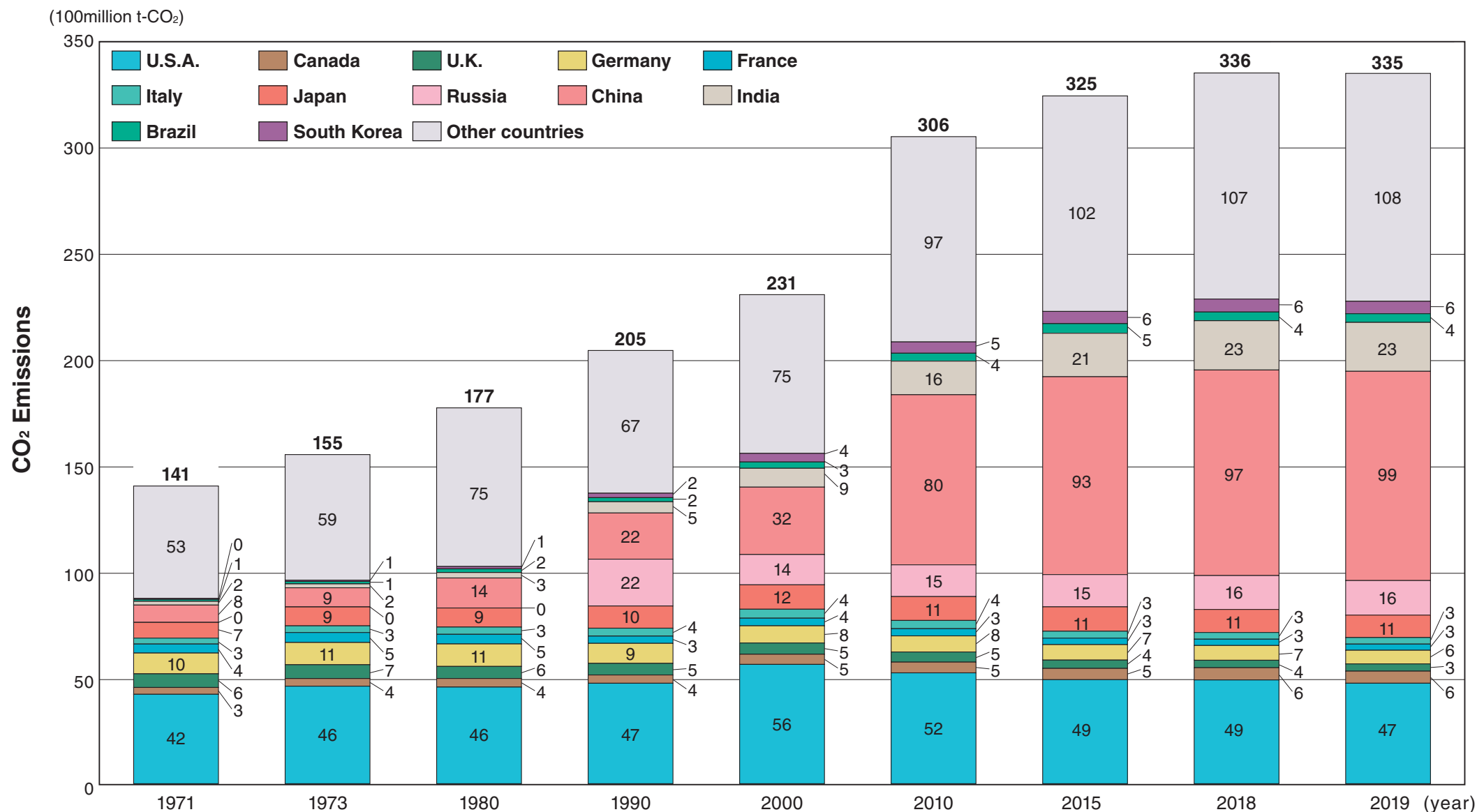
(Note) Figures may not add up to the totals due to rounding.  
GHGs: Greenhouse Gases

# Changes in CO<sub>2</sub> Emissions from Fossil Fuels and Atmospheric CO<sub>2</sub> Concentration in Japan



(Note) Figures may not add up to the totals due to rounding.

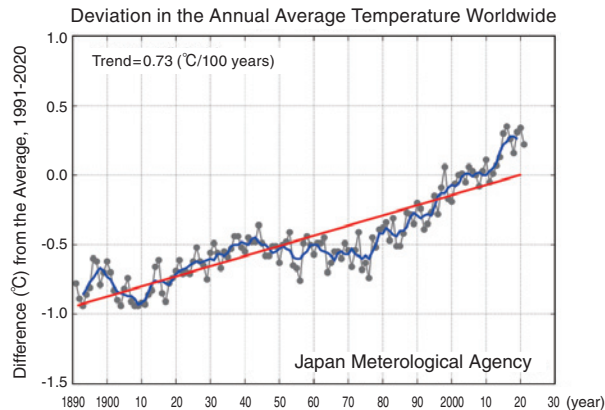
# Historical Trends in the World's CO<sub>2</sub> Emissions



(Note) Figures may not add up to the totals due to rounding.  
 Until 1990, Russia's CO<sub>2</sub> emissions are included in "Other countries".

# Changes in Average Temperatures

## Deviation in the Annual Average Temperature Worldwide (1891 to 2021)



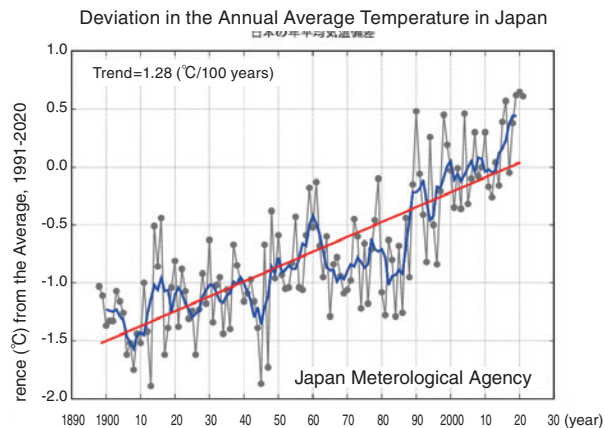
Dotted line (black) : Deviation from the reference value each year (difference from the 1991 to 2020 average)  
(Deviation in 2021 was +0.22°C)

Dotted line (blue) : Deviation in the 5-year moving average

Solid line (red) : Long-term trends  
(Rising at a rate of about 0.73°C/100 years)

Reference value is the 30-year average from 1991 to 2020.

## Deviation in the Annual Average Temperature in Japan (1898 to 2021)



Dotted line (black) : Deviation from the reference value at the 15 observation sites\* in Japan  
(Average deviation in 2021 was +0.61°C)

Dotted line (blue) : Deviation in the 5-year moving average

Solid line (red) : Long-term trends  
(Rising at a rate of about 1.28°C/100 years)

Reference value is the 30-year average from 1991 to 2020.

\*The 15 observation sites are in Abashiri, Nemuro, Suttsu, Yamagata, Ishinomaki, Fushiki, Iida, Choshi, Sakai, Hamada, Hikone, Miyazaki, Tadotsu, Naze, Ishigaki.

# Historical Temperatures and Predictions of Warming due to Increasing CO<sub>2</sub>

|                         |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------------|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Historical Temperatures | World | Rising at a rate of about 0.72°C/100 years* <sup>1</sup>                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                         | Japan | Rising at a rate of about 1.26°C/100 years* <sup>2</sup>                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Predicted Temperatures  | World | Global warming of 1.5°C and 2°C will be exceeded during the 21st century unless deep reductions in CO <sub>2</sub> and other greenhouse gas emissions occur in the coming decades* <sup>3</sup>                                                                                                                                                                                                                                                                                   |
|                         | Japan | <p>Rising 0.5 to 5.4°C by 2100*<sup>4</sup></p> <p>○RCP 2.6 scenario (lower stabilization scenario: assuming that the temperature rise is kept below 2 °C): 0.5 to 1.7 °C rise</p> <p>○RCP 8.5 scenario (high-level reference scenario: assuming no policy mitigation measures): 3.4 to 5.4 °C rise</p> <p>(RCP scenario is a scenario calculated from the idea of the concentration of greenhouse gases to be stabilized in the future, assuming policy mitigation measures)</p> |

# Efforts Toward Solving the Problem of Global Warming

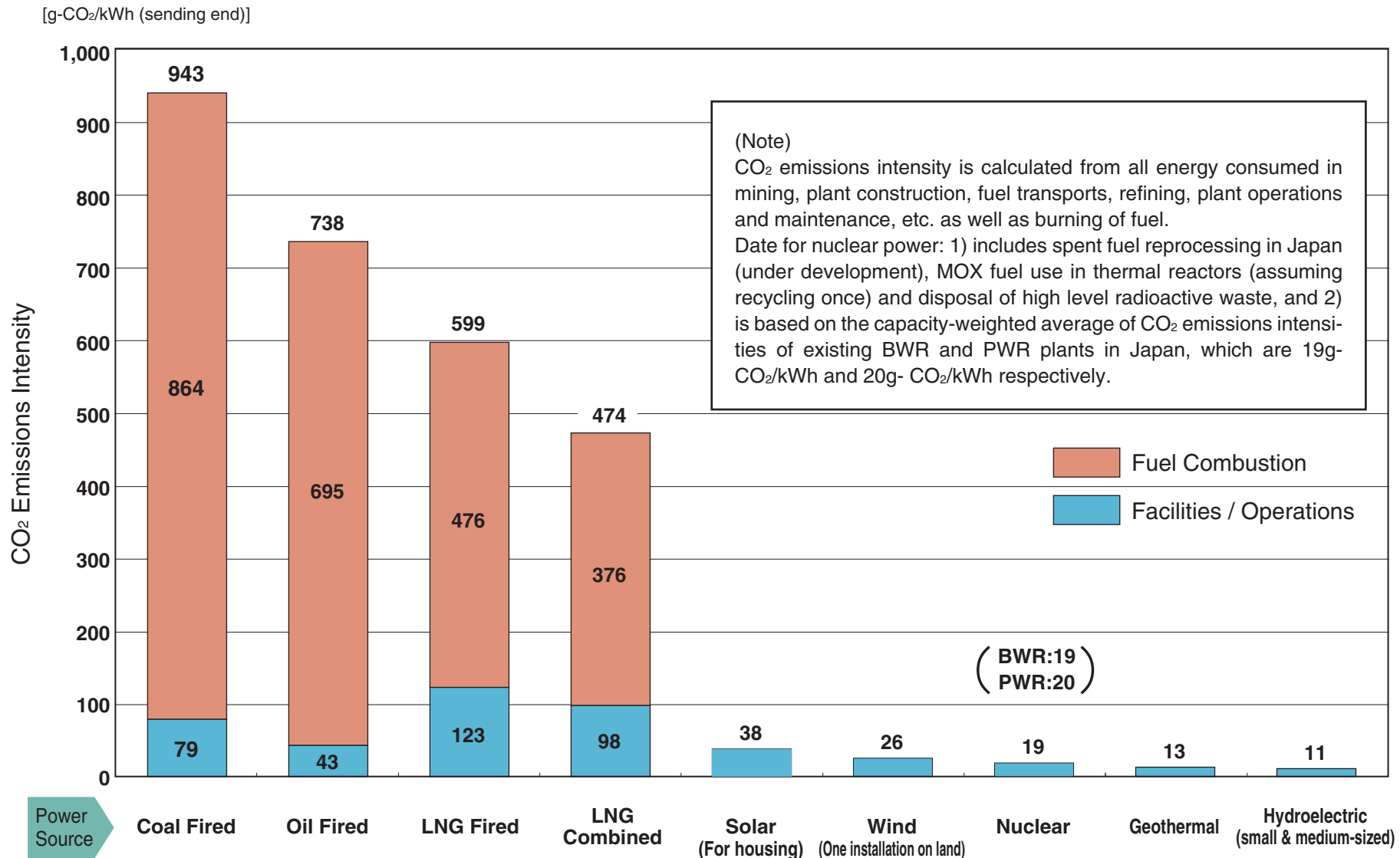
| Month/Year     | Location                | Organization          | Description                                                                                                                                                                                                                                                        |
|----------------|-------------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Nov. 1988      | Geneva, Switzerland     | IPCC established      | Established the first venue for discussions between governments on global warming                                                                                                                                                                                  |
| Mar. 1995      | Berlin, Germany         | COP1                  | Decided to discuss international agreements on numerical targets for greenhouse gas emission reductions                                                                                                                                                            |
| Dec. 1997      | Kyoto, Japan            | COP3                  | Set numerical targets for greenhouse gas emission reductions during the 1st greenhouse gas emission reductions agreement period (adopted the Kyoto Protocol)                                                                                                       |
| Oct.–Nov. 1999 | Bonn, Germany           | COP5                  | Many countries recognized the importance of bringing the Kyoto Protocol into effect by 2002                                                                                                                                                                        |
| Nov. 2000      | The Hague, Netherlands  | COP6                  | Failed to agree on measures on global warming, such as emissions-trading and offsets for carbon sinks in forests                                                                                                                                                   |
| Jul. 2001      | Bonn, Germany           | Resumption of COP6    | Agreed to offsets for forest carbon sinks                                                                                                                                                                                                                          |
| Oct.–Nov. 2001 | Marrakesh, Morocco      | COP7                  | Final agreement on the operational rules for the Kyoto Protocol                                                                                                                                                                                                    |
| Oct.–Nov. 2002 | New Delhi, India        | COP8                  | Progress toward the early adoption of the Kyoto Protocol                                                                                                                                                                                                           |
| Dec. 2003      | Milan, Italy            | COP9                  | Discussed detailed rules for implementing the Kyoto Protocol                                                                                                                                                                                                       |
| Dec. 2004      | Buenos Aires, Argentina | COP10                 | Signatories confirmed definite achievements in the emissions reduction agreement                                                                                                                                                                                   |
| Nov.–Dec. 2005 | Montreal, Canada        | COP11 & CMP1          | Made improvements, such as full establishment of operational rules for the Kyoto Protocol and the CDM                                                                                                                                                              |
| Nov. 2006      | Nairobi, Kenya          | COP12 & CMP2          | Made improvements, including a framework for the future after the Kyoto Protocol (from 2013 on), for supporting developing countries and changes to the CDM                                                                                                        |
| Dec. 2007      | Bali, Indonesia         | COP13 & CMP3          | Discussed the framework for after 2013 and support for developing countries (adopted the Bali Roadmap)                                                                                                                                                             |
| Dec. 2008      | Poznan, Poland          | COP14 & CMP4          | Discussions held with the aim of reaching agreement on the framework after 2013 by the end of 2009                                                                                                                                                                 |
| Dec. 2009      | Copenhagen, Denmark     | COP15 & CMP5          | Decided to keep the Copenhagen Accord on the table                                                                                                                                                                                                                 |
| Nov.–Dec. 2010 | Cancun, Mexico          | COP16 & CMP6          | Formally determined the content of the Copenhagen Accord                                                                                                                                                                                                           |
| Nov.–Dec. 2011 | Durban, South Africa    | COP17 & CMP7          | Extended the Kyoto Protocol and adopted the Durban Platform for bringing a new legal framework into place in 2020                                                                                                                                                  |
| Nov.–Dec. 2012 | Doha, Qatar             | COP18 & CMP8          | Adopted the Doha Climate Gateway, incorporating elements such as an action plan for creating a new framework in force to 2020, as well as an 8-year extension of the Kyoto Protocol                                                                                |
| Nov. 2013      | Warsaw, Poland          | COP19 & CMP9          | Laid the groundwork for agreement on the framework after 2020                                                                                                                                                                                                      |
| Dec. 2014      | Lima, Peru              | COP20 & CMP10         | Adopted the Lima Statement for Climate Action                                                                                                                                                                                                                      |
| Dec. 2015      | Paris, France           | COP21 & CMP11         | Adopted the Paris Agreement                                                                                                                                                                                                                                        |
| Nov. 2016      | Makelash, Morocco       | COP22, CMP12 & CMA1   | Discussion over the implementation guidelines of the Paris Agreement                                                                                                                                                                                               |
| Nov. 2017      | Bonn, Germany           | COP23, CMP13 & CMA1-2 | Implementation guideline of Paris Agreement negotiation, basic design of promotional dialogue, promotion of global climate action                                                                                                                                  |
| Dec. 2018      | Katowice, Poland        | COP24, CMP14 & CMA1-3 | Adopted implementation guidelines for the Paris Agreement for full operation of the Paris Agreement after 2020                                                                                                                                                     |
| Dec. 2019      | Madrid, Spain           | COP25, CMP15 & CMA2   | Discussion over the implementation guidelines in the Paris Agreement Article 6 (Market Mechanism)                                                                                                                                                                  |
| Oct.–Nov. 2021 | Glasgow, United Kingdom | COP26, CMP16 & CMA3   | The agreement calls for net zero greenhouse gas emissions by the midpoint of this century as well as ambitious mitigation and adaptation measures to be implemented by 2030, while relying on the latest scientific knowledge. Finalization of the Paris Rulebook. |

(Note) 1st greenhouse gas emission reductions agreement period: 2008 to 2012; Kyoto Protocol took effect Feb. 16, 2005

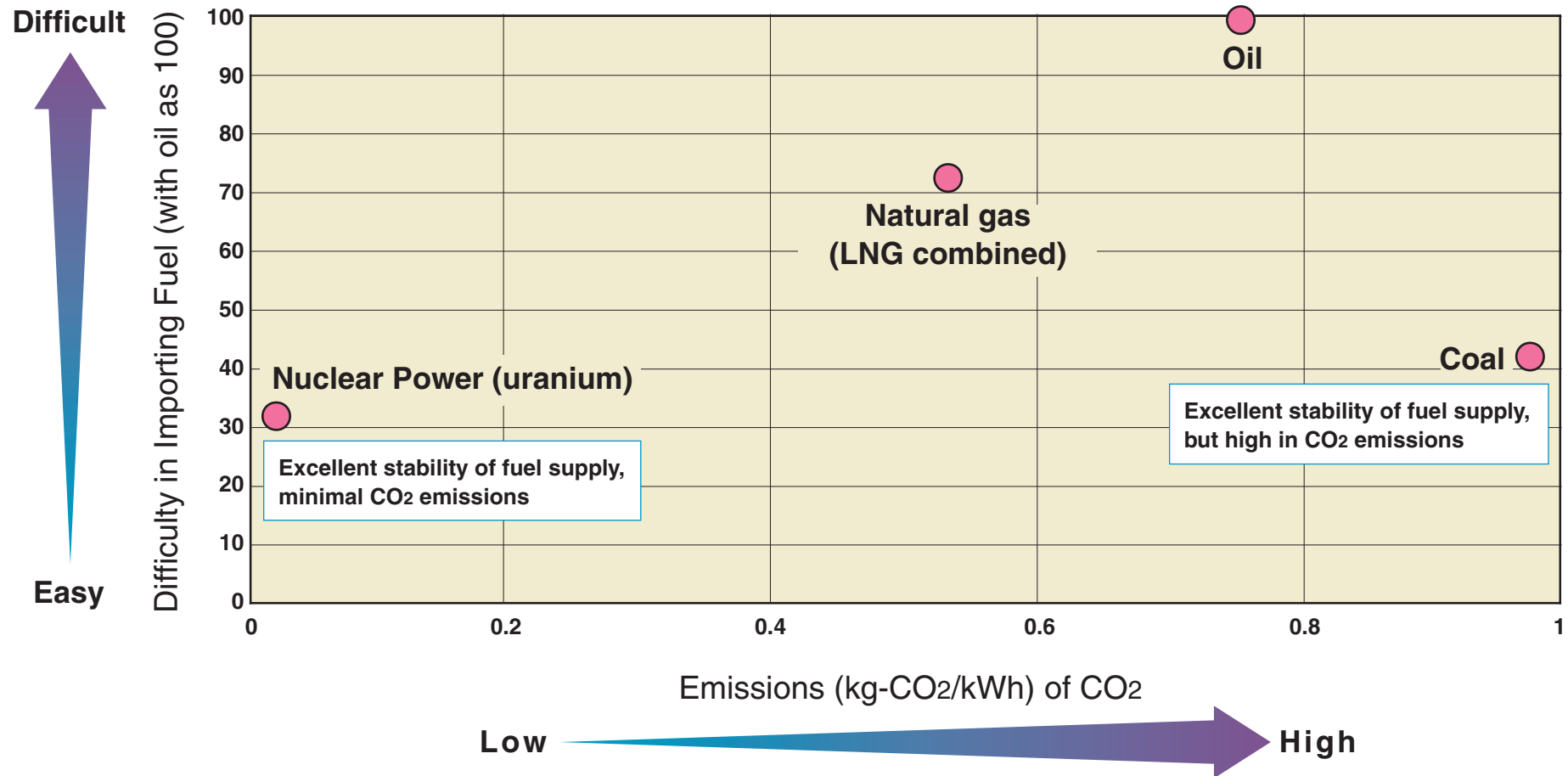
IPCC: Intergovernmental Panel on Climate Change   COP: Conference of the Parties   CMP: Meeting of the Parties (to the Kyoto Protocol)   CDM: Clean Development Mechanism   CMA: Meeting of the Parties to the Paris Agreement



# Lifecycle-Assessed CO<sub>2</sub> Emissions Intensity of Japan's Energy Sources



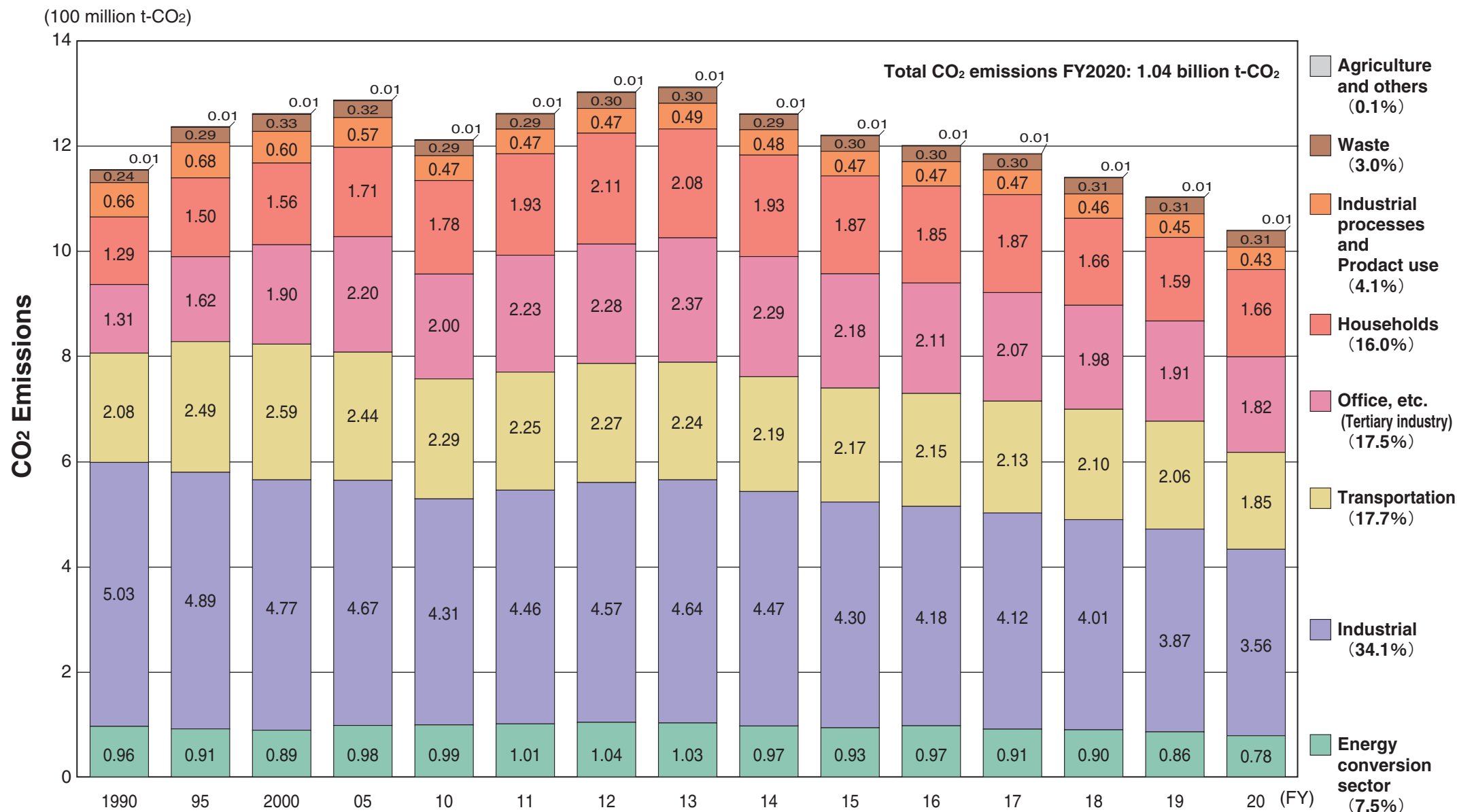
# Various Power Sources in Terms of CO<sub>2</sub> Emissions and Stability of Energy Resource Procurement



(Note) Degree of difficulty of importing fuel = (difficulty of ensuring world energy resources) + (difficulty of ensuring resources from supplier to Japan)  
 = (Imbalance in location of resource reserve + imbalance in volume exported) x (political & economic stability of each country)  
 + (imbalance in suppliers to Japan) x (political & economic stability of each country)

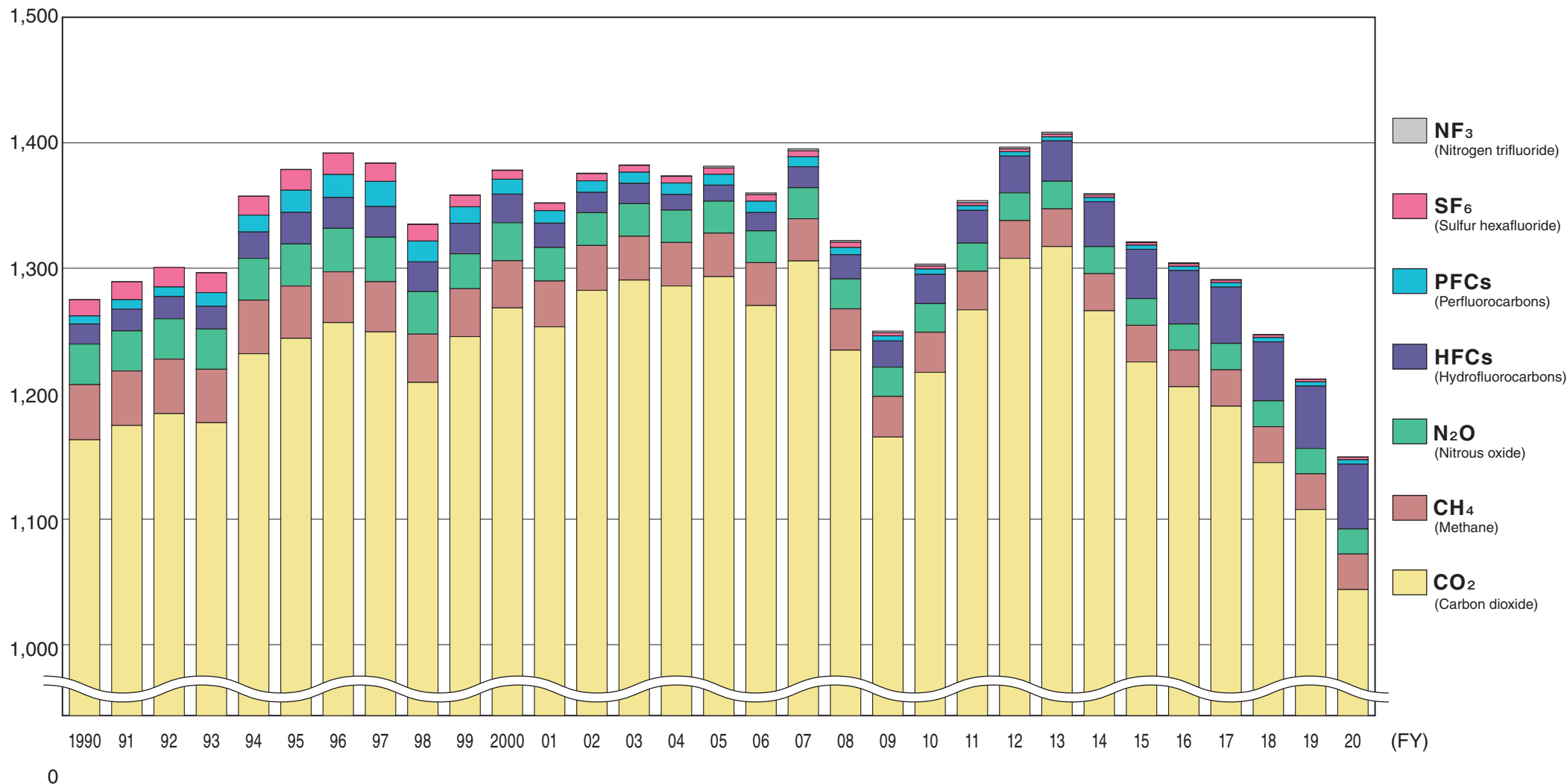
Countries are rated on their political and economic stability on a 10 step scale of 0.1 to 1.0 by Nippon Export and Investment Insurance; for example, Australia is rated a 0.1, while Afghanistan is a 1.0.

# Japan's Changes in CO<sub>2</sub> Emissions by Sector

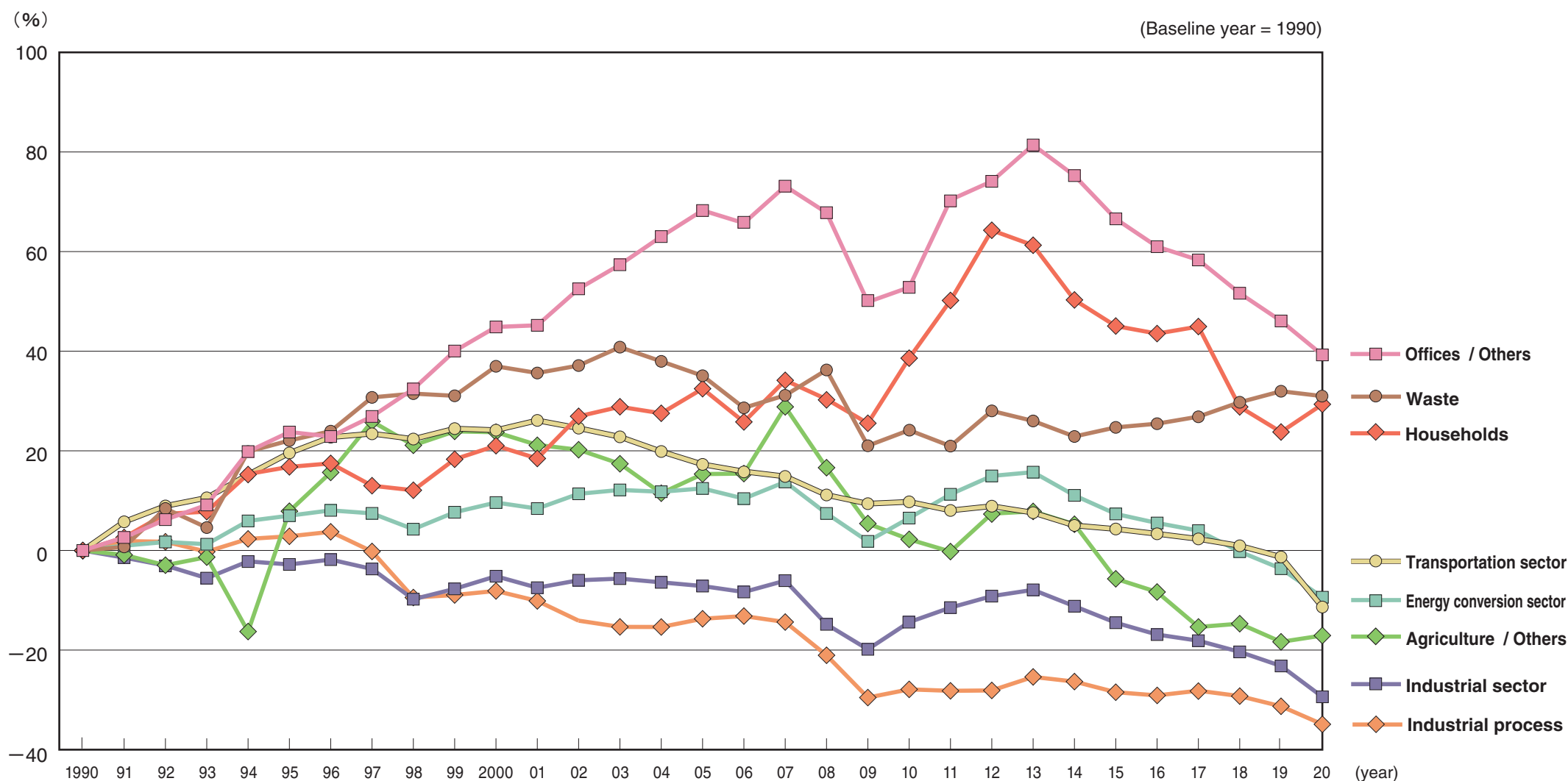


# Changes in GHGs Emissions in Japan

(million t-CO<sub>2</sub>)

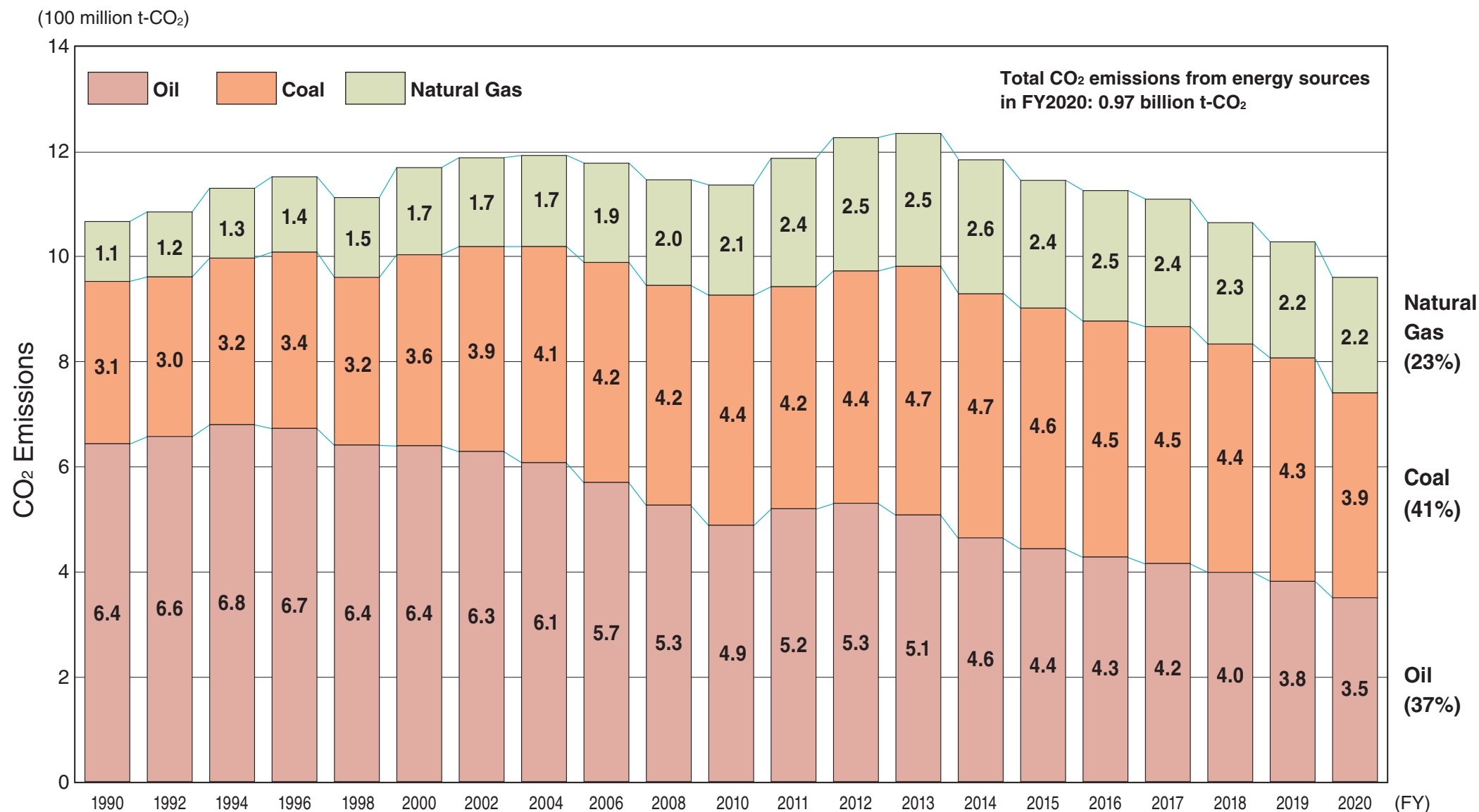


# Changes in Percent Increase/Decrease CO<sub>2</sub> Emissions by Sector in Japan



(Note) The numerical values show the increase and decrease of the indirect emissions (CO<sub>2</sub> emissions associated with power generation or heat generation are allocated to individual end demand sectors according to the electricity and heat consumption).

# Changes in CO<sub>2</sub> Emissions by Energy Source



(Note) Figures may not add up to the totals due to rounding.

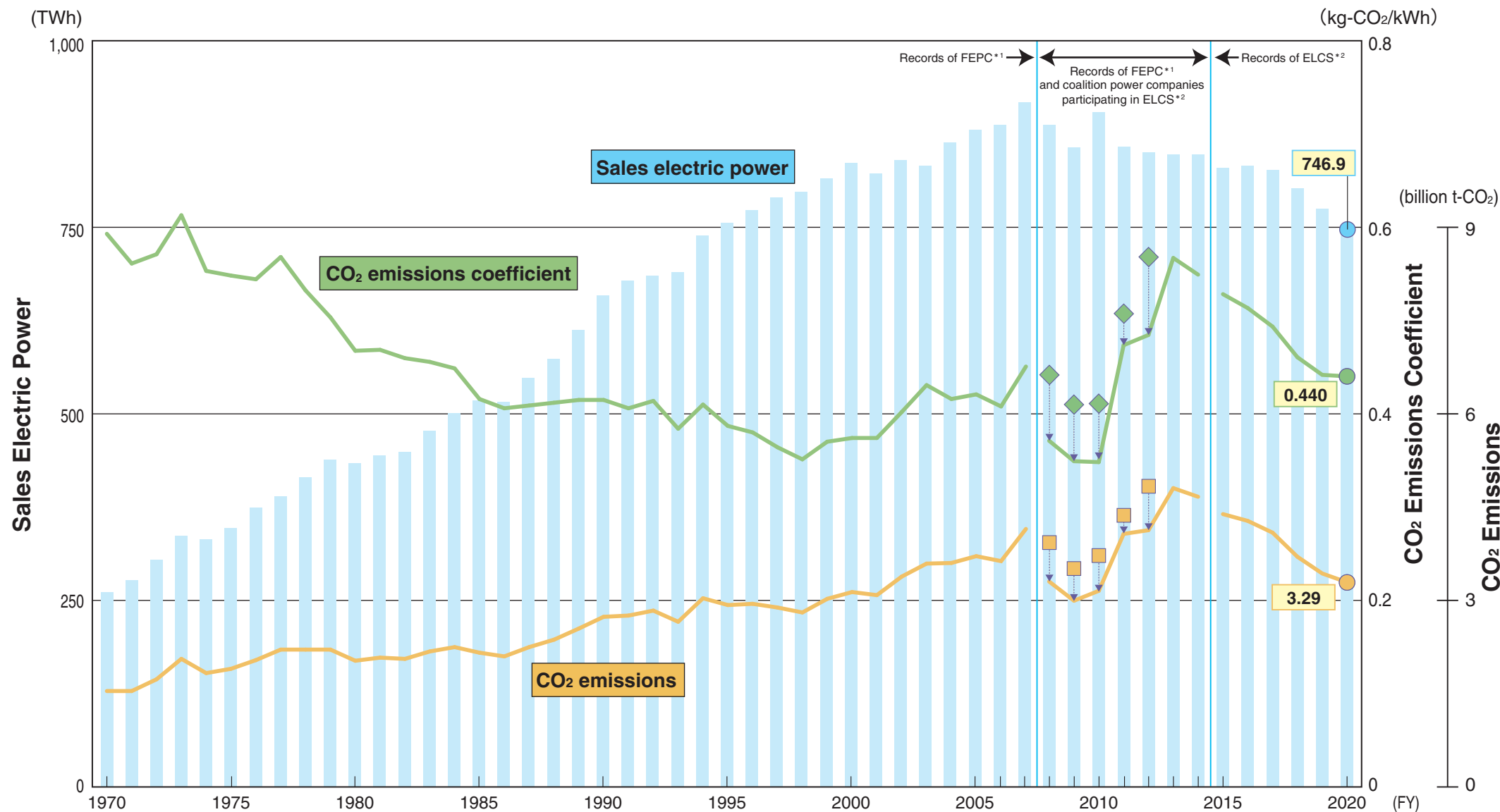
# Measures by Japan's Electric Power Industry to Reduce CO<sub>2</sub> Emissions

|                                                                          |                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------------------------------------------------------------|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. 2020 Targets for Reducing Domestic Emissions from Business Activities | Target Standards                     | <ul style="list-style-type: none"> <li>○ From the perspective of simultaneously achieving S+3E--the prerequisite of ensuring Safety (S), along with the (3 Es) of Energy security, Economic viability and Environmental conservation, and under the premise of pursuing an ideal mix of energy sources, take steps on both the electricity demand and supply side and continue to strive to realize a low-carbon society.</li> <li>○ When newly installing thermal generation, use the highest standard of technology that can be applied economically (BAT), according to the scale of the plant, in order to achieve a potential reduction that is forecast to be up to 7 million tons of CO<sub>2</sub>. *1, *2</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|                                                                          | Foundations for Establishing Targets | <p>Each participating company shall put together initiatives according to their business structure and strive to realize a low-carbon society.</p> <ul style="list-style-type: none"> <li>○ Promote the use of nuclear energy under the prerequisite of ensuring safety. <ul style="list-style-type: none"> <li>• In addition to implementing thorough safety measures at nuclear power plants, based on the lessons learned and knowledge gained from the Fukushima nuclear power plant accident, take independent, continuous steps to improve safety, not restricted to regulatory standards.</li> <li>• In order to gain the broad understanding of everybody in society, including residents living near plants, in addition to providing careful explanations, strive to safely and stably operate plants whose safe operation has been confirmed.</li> </ul> </li> <li>○ Promote the use of renewable energies <ul style="list-style-type: none"> <li>• Utilize hydro, geothermal, solar, wind and bio-mass energy sources.</li> <li>• Promote technological R&amp;D etc. for dealing with fluctuations in output of renewable energy sources.</li> </ul> </li> </ul> <p>Investigate measures for dealing with fluctuations in the output of solar power.<br/>Investigate introducing and expanding wind power generation, utilizing tie lines between regions.</p> <ul style="list-style-type: none"> <li>○ Strive to improve the efficiency of thermal plants, etc. <ul style="list-style-type: none"> <li>• When developing thermal generation, use the highest standard of technology that can be applied economically (BAT), according to the scale of the plant.</li> <li>• Strive to maintain the appropriate thermal efficiency of existing plants.</li> </ul> </li> <li>○ Strive to provide customer energy efficiency and low carbon services that contribute to a low carbon society. <ul style="list-style-type: none"> <li>• Strive to provide energy efficiency and low carbon services based on customer needs for a low carbon society in the field of electricity retailing.</li> </ul> </li> </ul> |
| 2.Strengthen Cooperation between Entities                                |                                      | <p>Recognize that in order to reduce electricity-related CO<sub>2</sub> emissions and improve the emissions factor, cooperation is essential between the government, which makes energy policies including those for nuclear power and renewable energy, and customers who use electricity via generation, transmission and distribution, and retailing. In addition to company's own efforts, linkages between the main players should be strengthened.</p> <ul style="list-style-type: none"> <li>○ From the perspective of getting customers to use electricity more efficiently, we will help them achieve CO<sub>2</sub> reductions by spreading the use of highly efficient electrical devices and through energy and CO<sub>2</sub> conserving initiatives.</li> <li>○ Work to introduce smart meters, as a green technology to help customers achieve more efficient use of electricity.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 3.Promote International Contributions                                    |                                      | <p>Contribute to reducing CO<sub>2</sub> in various countries by spreading overseas the technology and know-how gained by electricity companies in Japan.</p> <ul style="list-style-type: none"> <li>○ Support shifting to low carbon output in developing countries and transfer or supply Japanese power generation technologies via international partnership (GSEP) activities for energy efficiency, such as assessing coal-fired equipment and CO<sub>2</sub> reduction initiatives.</li> <li>○ Aim for a global shift to low carbon through the development and introduction of advanced and feasible electric power technologies based on trends in international schemes including Joint Crediting Mechanism (JCM).</li> </ul> <p>(Note) There is potential for a reduction of up to 500 million tons/year of CO<sub>2</sub> from coal fired power plants in the OECD and Asian developing countries in 2020 if high-efficiency plants are introduced and operations are improved.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 4.Development of Innovative Technologies                                 |                                      | <p>Continue to work to develop technologies that contribute to environmental protection on both the electricity demand and supply sides.</p> <ul style="list-style-type: none"> <li>○ Develop technologies for the use of nuclear power</li> <li>○ Thermal technologies that reduce environmental impact (A-USC, IGCC, CCS etc.)</li> <li>○ Manage the large-scale introduction of renewable energy (improvement of thermal plant load following, stabilization of transmission and distribution networks, increased adoption of biomass and geothermal generation, etc.)</li> <li>○ Develop technologies for the efficient use of energy</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

\*1: Review these targets and action plans as necessary based on trends in energy and environmental policies, technology development in Japan and overseas, and changes in the business environment, etc., while promoting the PDCA cycle.

\*2: Maximum reduction potential based on a comparison of the effect of adopting the BAT for the development of the main electricity sources from FY2013 onward instead of conventional technologies.

# Historical Trends in CO<sub>2</sub> Emissions from Electricity Generation in Japan

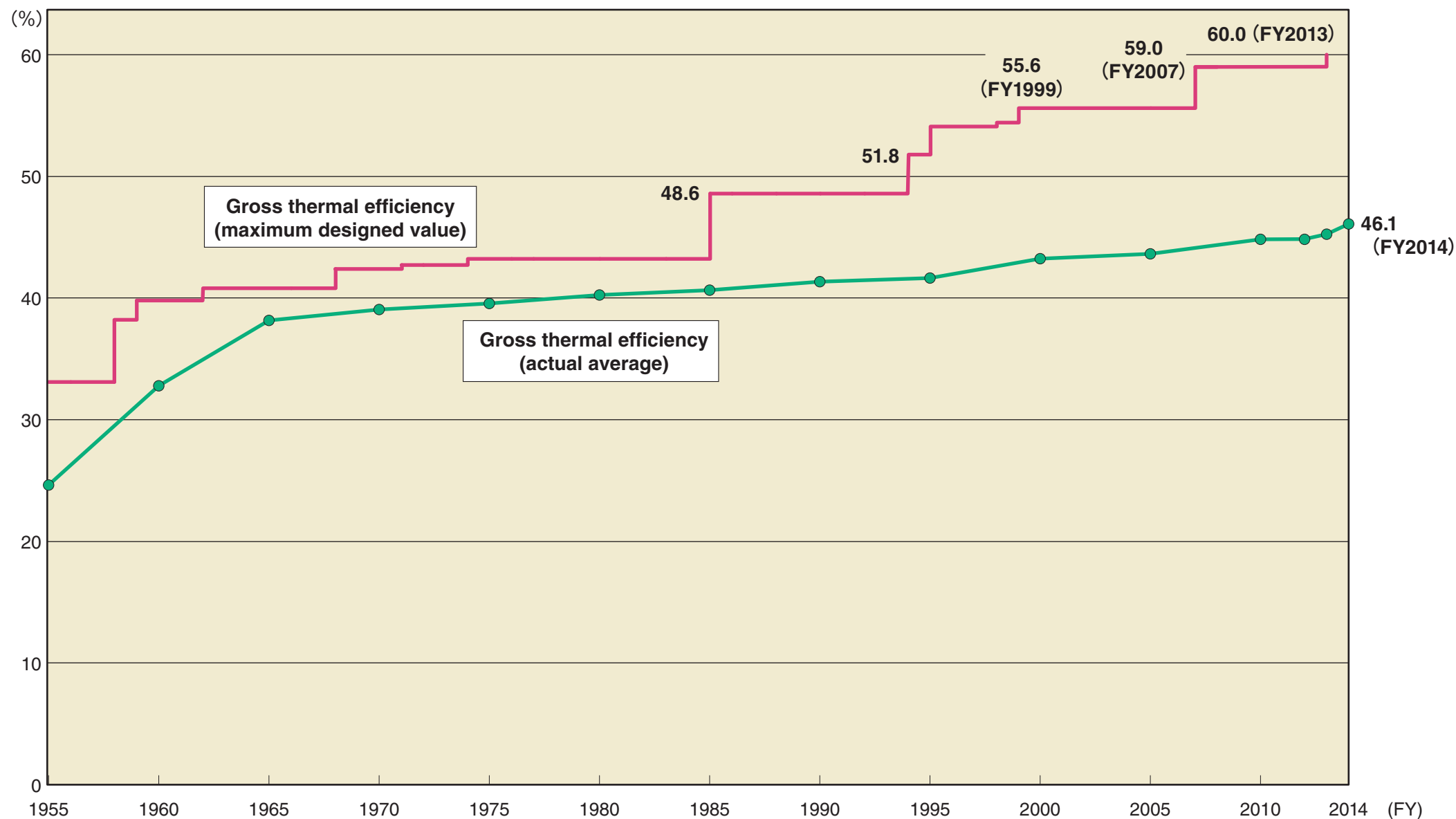


Note: For CO<sub>2</sub> emission amounts and emission coefficients, values shown for fiscal 2008–2019 records are after adjustment for FIT credit, etc., and values shown for fiscal 2008–2012 markers (◆ and ■) are base emissions.

\* 1 FEPC: Federation of Electric Power Companies \* 2 ELCS: Electric Power Council for a Low Carbon Society

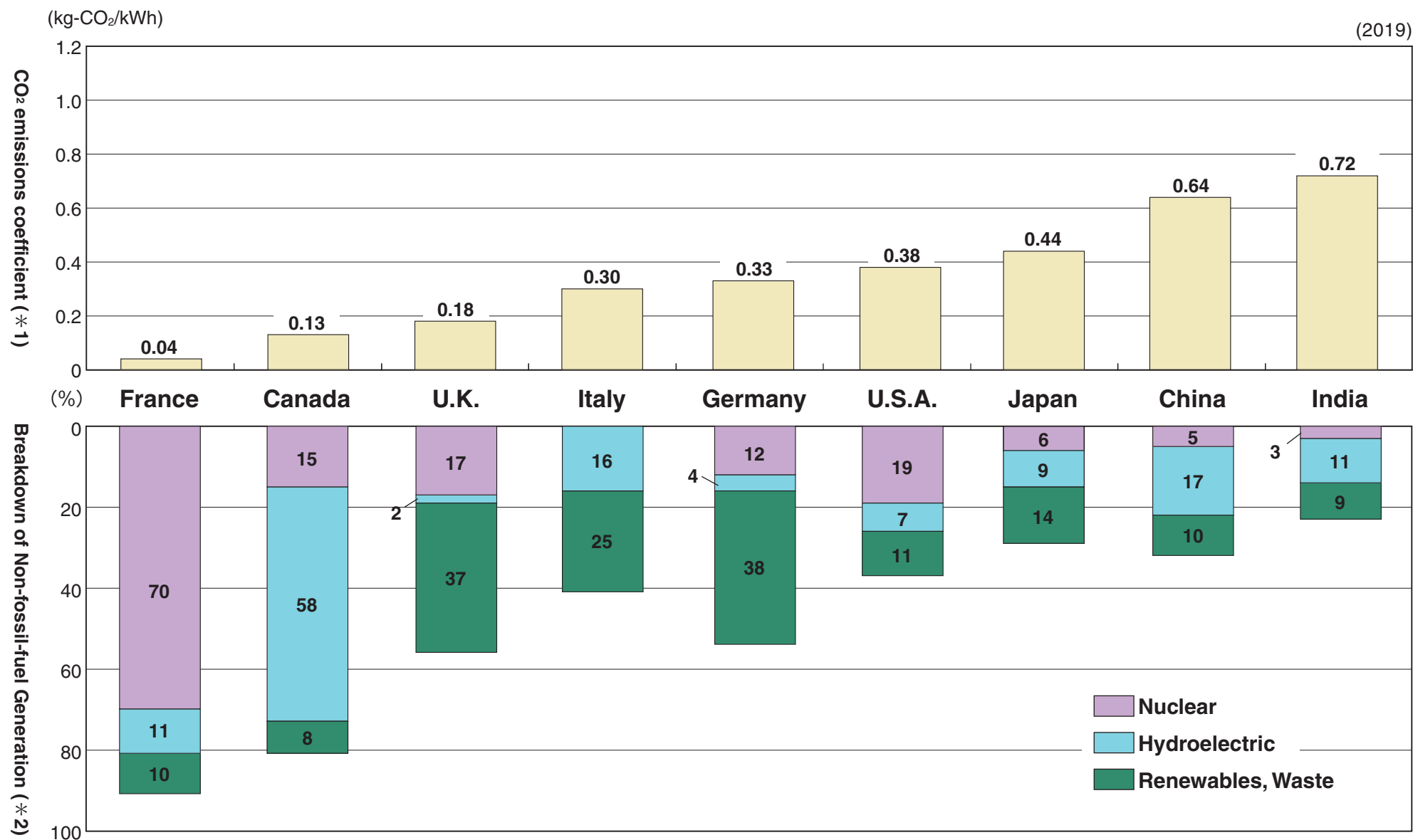


# Thermal Efficiency and T&D Loss Factor in Japan



(Note) Lower Heating Value: Estimated from the higher heating value standard based on the conversion factor from the Comprehensive Energy Statistics (FY2010).

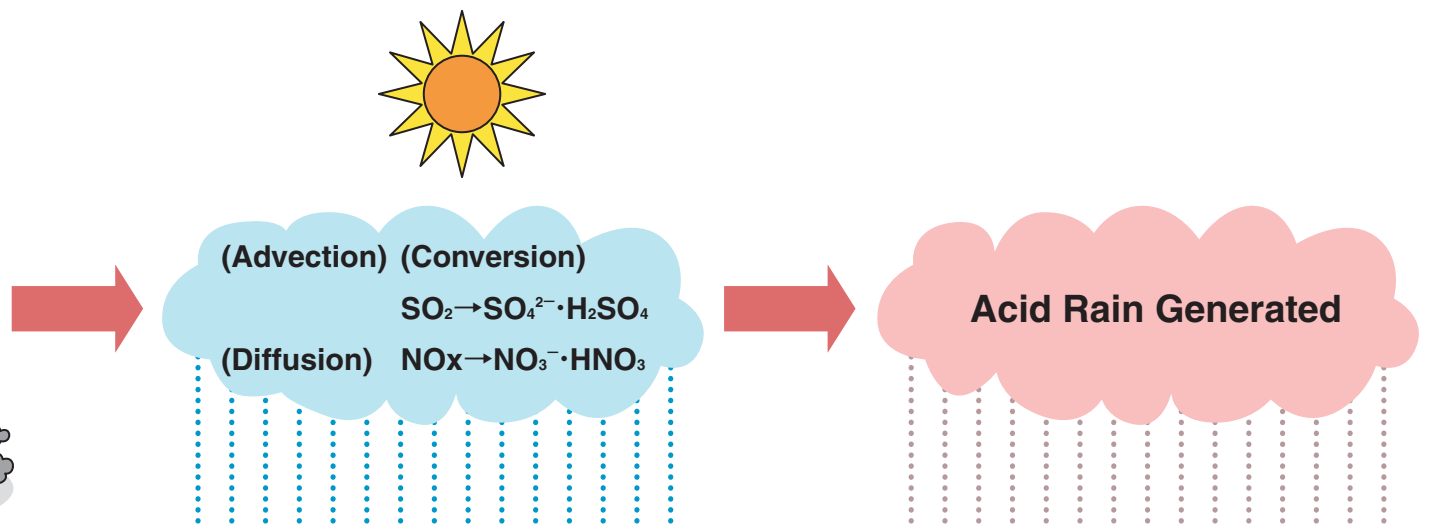
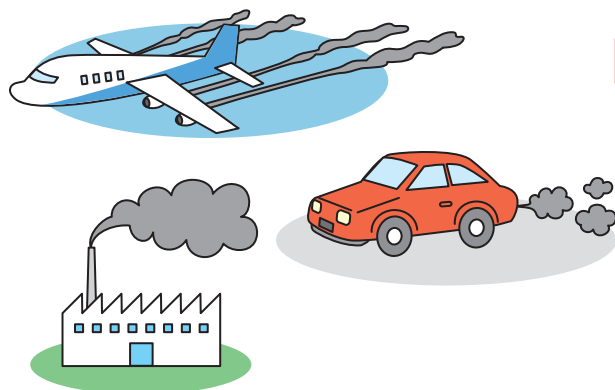
# Comparison of CO<sub>2</sub> Emissions Coefficient by Country



(Note) The figures contain Combined Heat and Power (CHP) plants. The figures of Japan contain non-utility generation facilities.

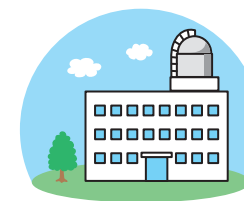
# Mechanisms in the Development of Acid Rain

Emission of SO<sub>2</sub> (sulfur dioxide)  
and NO<sub>x</sub> (nitrogen oxide)



Impacts

(Land/Water Systems) ← Impacts (Soil/Vegetation Systems) ← Impacts (Atmospheric Systems)



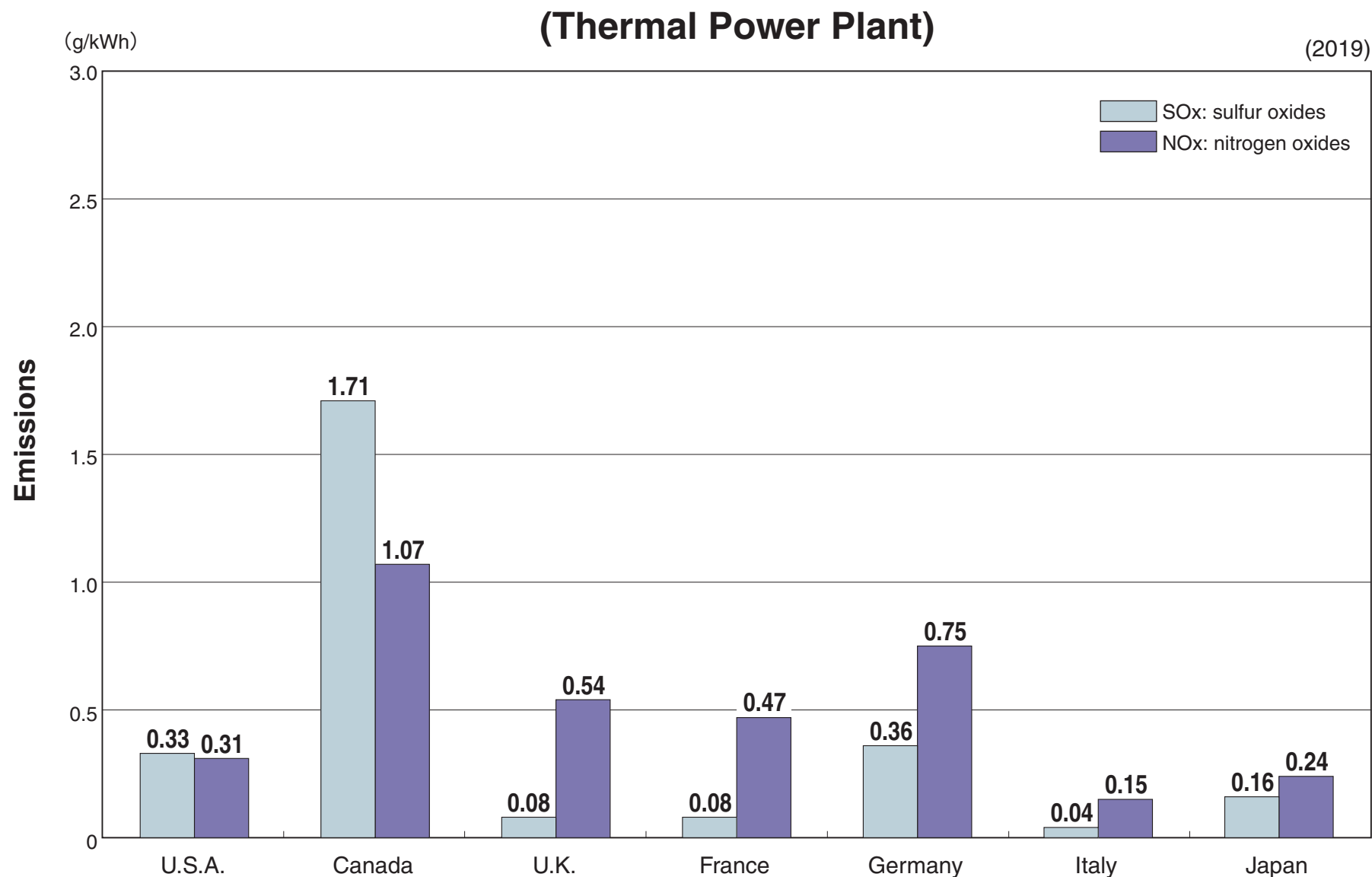
Impacts of Acid Rain

|                                         |
|-----------------------------------------|
| Lower pH in lakes, etc.                 |
| Increased concentration of toxic metals |

|                                           |                                        |
|-------------------------------------------|----------------------------------------|
| Leaching of bases, such as calcium        | Direct effects on trees and vegetation |
| Elution of toxic metals, such as aluminum |                                        |

Air monitoring stations

# SOx and NOx Emissions per Unit of Electricity Generated in Major Countries



※10 electric power companies and Electric Power Development Co. Ltd.